The EF-hand Ca2+ binding protein MICU choreographs mitochondrial Ca2+ dynamics in Arabidopsis

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Résumé en anglais	Plant organelle function must constantly adjust to environmental conditions, which requires dynamic coordination. Ca2+ signaling may play a central role in this process. Free Ca2+ dynamics are tightly regulated and differ markedly between the cytosol, plastid stroma, and mitochondrial matrix. The mechanistic basis of compartment-specific Ca2+ dynamics is poorly understood. Here, we studied the function of At-MICU, an EF-hand protein of Arabidopsis thaliana with homology to constituents of the mitochondrial Ca2+ uniporter machinery in mammals. MICU binds Ca2+ and localizes to the mitochondria in Arabidopsis. In vivo imaging of roots expressing a genetically encoded Ca2+ sensor in the mitochondrial matrix revealed that lack of MICU increased resting concentrations of free Ca2+ in the matrix. Furthermore, Ca2+ elevations triggered by auxin and extracellular ATP occurred more rapidly and reached higher maximal concentrations in the mitochondria of micu mutants, whereas cytosolic Ca2+ signatures remained unchanged. These findings support the idea that a conserved uniporter system, with composition and regulation distinct from the mammalian machinery, mediates mitochondrial Ca2+ uptake in plants under in vivo conditions. They further suggest that MICU acts as a throttle that controls Ca2+ uptake by moderating influx, thereby shaping Ca2+ signatures in the matrix and preserving mitochondrial homeostasis. Our results open the door to genetic dissection of mitochondrial Ca2+ signaling in plants.
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